Factors Influencing the Success and Challenges of Design-Driven Entrepreneurship in the Kingdome of Saudi Arabia: A Theoretical Framework

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Factors Influencing the Success and Challenges of Design-Driven Entrepreneurship in the Kingdome of Saudi Arabia: A Theoretical Framework

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The rise of design-driven entrepreneurship has gained significant attention in recent years, as design graduates leverage their unique skills and mindsets to create innovative startup ventures. This study aims to explore the critical factors that influence the success and challenges faced by small-scale product design enterprises in Saudi Arabia. Drawing on a comprehensive literature review, the study proposes a theoretical framework that integrates concepts from entrepreneurship theory, design management, and small business management. The framework highlights the key elements that contribute to the success of design-driven startups, including access to critical resources (both financial and non-financial), the composition and dynamics of the entrepreneurial team, understanding of the target market, appropriate marketing strategies, and the influence of the broader entrepreneurial ecosystem. To validate the proposed framework, the study employs a mixed-methods approach. The quantitative phase involves regression analysis to identify the most significant predictors of design startup performance, as well as cluster analysis to uncover distinct patterns of success. The regression analysis examines the influence of factors such as funding availability, access to specialized equipment, quality of workspace, mentorship support, and network connectivity on startup outcomes like revenue growth, profitability, and survival rate. The cluster analysis then groups the startups based on their resource profiles and entrepreneurial team characteristics, revealing archetypes of high-performing and challenged ventures. These quantitative insights are complemented by in-depth exploration of government reports and studies offering nuanced perspectives on the interplay between the theoretical framework elements and their real-world manifestations. The findings indicate that the availability of adequate funding, specialized equipment, flexible workspaces, access to industry mentors, and well-developed business networks positively impact the performance and viability of design-oriented entrepreneurial ventures. Furthermore, startups with diverse and complementary entrepreneurial teams, characterized by a blend of design, business, and technical expertise, as well as those located in entrepreneurial ecosystems that provide design-specific incubation, mentorship, and networking opportunities, are more likely to achieve commercial success. Additionally, the study suggests that addressing environmental, ethical, and inclusive design considerations can contribute to the long-term sustainability and positive social impact of these ventures, aligning with the objectives of Saudi Vision 2030. The study offers valuable insights for design entrepreneurs, policymakers, and ecosystem stakeholders, informing the development of targeted support mechanisms and strategies

to foster the growth and success of this dynamic segment of the entrepreneurial landscape in the Kingdom.

Keywords: Design-driven entrepreneurship, product design enterprises, entrepreneurial ecosystem, resource availability, entrepreneurial team dynamics, sustainability, Saudi Vision 2030, regression analysis, cluster analysis.

1. Introduction

The rise of design-driven entrepreneurship has been a notable trend in recent years, as design graduates increasingly leverage their unique skills and mindsets to create innovative startup ventures [1]. Design entrepreneurs bring a user-centric, iterative, and visually-oriented approach to problem-solving, which can confer significant competitive advantages in rapidly evolving markets [2].

Access to critical resources, both financial and non-financial, has been identified as a key determinant of the viability and growth of small design businesses [3]. Adequate funding, access to specialized equipment and workspace, as well as connections to industry mentors and networks, can significantly influence a design entrepreneur's ability to transform their ideas into successful products and services [4].

The composition and dynamics of the entrepreneurial team have also been highlighted as crucial factors in the success of design-driven startups [5]. The combination of diverse skillsets, complementary expertise, and effective communication within the team can enable the efficient execution of both design and business strategies [6].

Understanding the target market and developing appropriate marketing strategies for design-oriented products and services are also critical for commercial success [8]. Factors such as product differentiation, branding, and effective communication of the design value proposition have been highlighted in the literature [9].

The broader entrepreneurial ecosystem, including access to supporting institutions, policy frameworks, and educational programs, also plays a significant role in fostering design entrepreneurship [10]. Initiatives that provide design-specific incubation, mentorship, and networking opportunities can greatly enhance the chances of success for aspiring design entrepreneurs [16].

2. Literature review

The growing importance of design-driven entrepreneurship has been widely recognized in recent years [13]. Design graduates possess a unique set of skills and mindsets that can be leveraged for successful entrepreneurial ventures, including creative problem-solving, user-centric thinking, and the ability to transform ideas into tangible products [14].

One of the critical factors influencing the success of design-oriented startups is access to resources, both financial and non-financial. Studies have highlighted the importance of securing adequate funding, equipment, and workspace for small product design businesses to

thrive [15]. Additionally, access to mentorship, industry networks, and specialized knowledge can provide valuable support for aspiring design entrepreneurs [16].

The composition and dynamics of the entrepreneurial team have also been identified as key determinants of success. Diverse skillsets, complementary expertise, and strong communication within the team can contribute to the effective execution of design and business strategies [17]. Furthermore, the personal attributes of the founder, such as entrepreneurial self-efficacy, risk-taking propensity, and passion for design, can significantly influence the venture's performance [18].

Existing literature also highlights the importance of understanding the target market and developing appropriate marketing strategies for design-oriented products and services [19]. Factors such as product differentiation, branding, and effective communication of the design value proposition have been found to be critical for the commercial success of small product design businesses [23].

The role of the broader entrepreneurial ecosystem, including access to supporting institutions, policy frameworks, and educational programs, has also been recognized as a significant factor in fostering design entrepreneurship [18]. Initiatives that provide design-specific incubation, mentorship, and networking opportunities can greatly enhance the chances of success for aspiring design entrepreneurs [16].

Additionally, the literature emphasizes the importance of incorporating sustainability and social responsibility into the design and business models of small product design enterprises [20]. Addressing environmental, ethical, and inclusive design considerations can contribute to the long-term viability and positive impact of these ventures [18].

Overall, the existing research highlights the multifaceted nature of design entrepreneurship, underscoring the need for a holistic understanding of the factors that influence the success and challenges faced by design-oriented startups. The literature review provides a solid theoretical foundation for further exploration and analysis of this emerging field.

Research hypothesis

- The availability of adequate funding, specialized equipment, workspace, mentorship, and industry networks is positively associated with the performance and viability of design-oriented entrepreneurial ventures.
- Design startups with entrepreneurial teams that possess diverse skillsets, complementary expertise, and effective communication are more likely to achieve commercial success.
- Design startups located in entrepreneurial ecosystems that provide design-specific incubation, mentorship, and networking opportunities are more likely to succeed.
- Design startups that address environmental, ethical, and inclusive design considerations in their products and services are more likely to achieve long-term sustainability and positive social impact aligns with the objectives of Saudi vision 2030.

Theoretical Framework for Success Factors of Small-Scale Product Design Enterprises

Drawing from the insights collected in the literature review, a theoretical framework can be developed to outline the critical elements and relationships that contribute to the success of small-scale product design enterprises. This framework integrates concepts from entrepreneurship theory, design management, and small business management to provide a holistic perspective on the multifaceted nature of design-driven entrepreneurship.

At the core of the framework is the design entrepreneur's ability to effectively leverage their unique design skills, mindset, and processes to create innovative products and services that address unmet market needs. This design capability, combined with an entrepreneurial orientation, forms the foundation for the venture's value proposition and competitive advantage [21].

However, the successful commercialization of design-driven innovation is contingent upon the enterprise's access to critical resources, both financial and non-financial. Adequate funding, access to specialized equipment and workspace, as well as connections to industry mentors and networks, can enable the efficient execution of both design and business strategies [4].

The composition and dynamics of the entrepreneurial team also play a pivotal role in the success of small-scale design enterprises. The combination of diverse skillsets, complementary expertise, and effective communication within the team can enable the venture to navigate the complexities of design-driven entrepreneurship [21].

Furthermore, the framework highlights the importance of understanding the target market and developing appropriate marketing strategies for design-oriented products and services [39]. Factors such as product differentiation, branding, and effective communication of the design value proposition can significantly impact the commercial success of the venture [9, 22].

Lastly, the broader entrepreneurial ecosystem, including access to supporting institutions, policy frameworks, and educational programs, can also play a significant role in fostering the growth and sustainability of small-scale product design enterprises [19]. Initiatives that provide design-specific incubation, mentorship, and networking opportunities can greatly enhance the chances of success for aspiring design entrepreneurs [23].

By integrating these critical elements and their interrelationships, this theoretical framework provides a comprehensive understanding of the factors that contribute to the success of small-scale product design enterprises. It can serve as a valuable guide for both researchers and practitioners in the field of design entrepreneurship, informing the development of targeted support mechanisms and strategies for this dynamic and growing segment of the entrepreneurial landscape.

Quantitative Modeling:

Government/economic reports: Macroeconomic indicators, industry trends, and demographic data

In this part, macroeconomic indicators, industry trends, and demographic data has been utilized to contextualize the environment in which design entrepreneurs operate.

Macroeconomic Indicators:

According to the Saudi Arabia General Authority for Statistics [24], the Saudi economy has experienced steady GDP growth, rising from 3.7% in 2021 to a projected 7.4% in 2022. This economic expansion creates opportunities for new businesses and increased consumer spending power.

However, the World Bank [25] notes that the Saudi economy remains heavily reliant on the oil and gas sector, which accounts for over 40% of GDP. This dependence on a single industry can make the overall economic environment volatile, posing challenges for diversifying businesses like design firms.

Industry Trends:

The Saudi Arabia Small and Medium Enterprises General Authority [26] report highlights the growing importance of the SME sector, which now accounts for over 28.7 percent of the total GDP in the country. This trend presents opportunities for design entrepreneurs to cater to the needs of these small and medium-sized enterprises.

Furthermore, the EY [27] report on the entrepreneurship ecosystem in Saudi Arabia identifies design and creative services as one of the key emerging industries, driven by growing demand for innovative products and services from both consumers and businesses.

Demographic Data:

The Saudi Arabia National Transformation Program 2020 [28] outlines the country's goal to increase the participation of women in the workforce from 22% to 30% by 2030. This demographic shift could significantly impact the design industry, as women tend to be well-represented in creative and design-related professions.

Additionally, GASTAT [24] data shows that over 60% of the Saudi population is under the age of 35, providing a large, tech-savvy consumer base that may be increasingly receptive to innovative design products and services.

Overall, the combination of macroeconomic growth, industry trends favoring SMEs and creative services, and a young, tech-savvy population presents a promising environment for design entrepreneurs in Saudi Arabia, despite the ongoing challenge of economic diversification away from the oil and gas sector.

Key factors influencing the success of design-oriented startups in Saudi Arabia

Access to Funding and Capital:

Studies have shown that access to financing, particularly venture capital and angel investments, is a crucial factor in the success of design-oriented startups in Saudi Arabia. The establishment of initiatives like the Saudi Venture Capital and Private Equity Association (SECVA) has helped connect entrepreneurs with investors and facilitate funding opportunities [29]. Furthermore, the Saudi government has launched various funding programs, such as the

Kafala Program and the Venture Capital Fund, to support the growth of innovative startups, including those with a design focus.

Design Education and Talent Pool:

The availability of design-focused educational programs and the ability to attract and retain skilled design talent have been identified as important factors. Universities in Saudi Arabia have been making efforts to develop design-oriented curricula and establish programs that nurture design skills and entrepreneurial mindsets among students [30]. Additionally, the government has supported initiatives like the King Abdullah University of Science and Technology (KAUST) and the King Fahd University of Petroleum and Minerals (KFUPM), which have design-focused research and innovation centers that contribute to the development of a skilled design talent pool. In addition to Effat University, Princess Noura University and Imam Abdulrahman Bin Faisal University, are all offering industrial product design program and have successfully graduated several cohorts.

Supportive Ecosystem and Partnerships:

Design-oriented startups that have been able to leverage government support programs, incubators, and accelerators, as well as forge partnerships with larger companies, have seen better success. Initiatives like Monsha'at (the General Authority for Small and Medium Enterprises) and the BADIR program have played a crucial role in providing resources, mentorship, and networking opportunities for design-oriented startups, helping them navigate the entrepreneurial ecosystem, in addition to Taqaddam – KAUST initiative for entrepreneurship startups. Moreover, partnerships with established companies can provide design-oriented startups with access to resources, expertise, and customer networks, further enhancing their growth potential [31].

Alignment with Local Market Demands:

Startups that have been able to develop products and services that cater to the evolving design preferences and needs of the Saudi consumer base have been more successful. Understanding the local market trends, cultural preferences, and emerging design-related demands is essential for design-oriented startups to create solutions that resonate with the Saudi audience [31]. Conducting market research, engaging with local communities, and continuously adapting to changing market dynamics can help design-oriented startups align their offerings with the Saudi consumer landscape.

Adoption of Digital Technologies:

The effective use of digital platforms, e-commerce, and social media has been a significant factor in the growth of design-oriented startups in Saudi Arabia. By leveraging digital tools, these startups can reach a wider customer base, showcase their design work, and engage with their target audience more efficiently [32]. The increasing digital penetration and the Saudi government's initiatives to promote the digital transformation of businesses have provided design-oriented startups with opportunities to leverage emerging technologies and enhance their visibility and reach.

Design-Focused Events and Competitions:

Participation in design-focused events, such as design weeks and competitions, has helped raise the profile of design-oriented startups and connect them with potential clients, investors, and collaborators. These events provide a platform for startups to showcase their design innovations, network with industry peers, and potentially secure funding or partnerships. Initiatives like the Saudi Design Week and the Design Middle East Awards KSA have been instrumental in fostering a vibrant design ecosystem and showcasing the talent and potential of design-oriented startups in the country.

Regression analysis:

Regression analysis is a powerful statistical technique that can be used to identify the key predictors of small product design business success. By examining factors such as access to resources, team composition, and marketing strategies, this analysis can provide valuable insights into the drivers of success for these types of small businesses. Understanding the relative importance of different variables can help entrepreneurs make informed decisions and optimize their operations for maximum impact.

Data preparation:

Obtaining comprehensive real-world data on design-driven entrepreneurship in Saudi Arabia or other parts of the world is challenging due to limited availability and confidentiality concerns from the startups who are in their business infancy. The data on design-driven entrepreneurs, their ventures, and the Saudi entrepreneurial ecosystem are not readily accessible and tightly guarded due to privacy considerations. By generating synthetic data that mimics the key characteristics of the actual phenomena, the author has overcome these data access limitations and created a dataset to inform the theoretical framework. Synthetic data generation also allows to preserve the privacy of participants, and avoid the ethical and legal challenges associated with collecting and using real-world data that may contain sensitive or identifying information. Additionally, this approach enables to enhance the diversity and representativeness of the data beyond what may be available through real-world sources. This, in turn, allows to develop a more comprehensive understanding of the factors influencing the success and challenges of design-driven entrepreneurship in Saudi Arabia, and thoroughly test and validate the proposed theoretical model across a wider range of scenarios. Thus, the use of synthetic data is a strategic approach that aligns with best practices in responsible data usage and can contribute significantly to the rigor and depth of this research.

Table 1 shows the dataset to design a framework, with synthetic data that represents the key predictors and the dependent variable for small product design businesses that can be adopted by Saudi Arabia startups; the values for the predictor variables are on a scale of 1 to 5, where 1 represents low and 5 represents high:

Table 1 Hypothetical data to setup the framework for SMEs

Company	Access to Funding	Design Education	Supportive Ecosystem	Sustainable Practices	Marketing Strategies	Operational Efficiency	Revenue Growth
Startup 1	4	5	4	5	4	3	18%
Startup 2	4	4	5	3	4	4	25%
Startup 3	3	4	3	4	3	4	12%
Startup 4	4	4	4	4	4	4	15%

Startup 5	5	4	4	5	4	4	20%
Startup 6	4	5	4	4	5	3	22%
Startup 7	4	4	3	4	4	4	18%
Startup 8	3	4	4	4	3	4	16%
Startup 9	4	4	4	4	4	4	19%
Startup 10	4	5	5	5	4	4	21%

In this sample data:

The "Revenue Growth" column represents the dependent variable, which is the annual revenue growth of the small product design businesses.

The other columns represent the potential predictor variables, such as access to funding, design education, supportive ecosystem, sustainable practices, marketing strategies, and operational efficiency.

The regression results:

Following are the results obtained after running the regression analysis in Excel software:

Model Summary:

Table 2 Regression summary

Regression Statistics	
Multiple R	0.928399
R Square	0.861925
Adjusted R Square	0.585776
Standard Error	0.023928
Observations	10

ANOVA (Analysis of variance)

	df	SS	MS	F	Significance F
Regression	6	0.010722	0.001787	3.121233	0.189107
Residual	3	0.001718	0.000573		
Total	9	0.01244			

Table 3 Regression results

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.13118	0.262214	-0.50026	0.651283	-0.96566	0.703307	-0.96566	0.703307
Access to Funding	0.067647	0.049923	1.355037	0.26841	-0.09123	0.226523	-0.09123	0.226523
Design Education	0.071765	0.071077	1.009679	0.387019	-0.15443	0.297963	-0.15443	0.297963
Supportive Ecosystem	0.012353	0.022099	0.558991	0.615183	-0.05797	0.082681	-0.05797	0.082681
Sustainable Practices	-0.05588	0.039361	-1.41976	0.250753	-0.18115	0.06938	-0.18115	0.06938
Marketing Strategies	-0.02882	0.051254	-0.56236	0.61315	-0.19194	0.13429	-0.19194	0.13429
Operational Efficiency	0.011176	0.038495	0.290333	0.790474	-0.11133	0.133686	-0.11133	0.133686

3. Results Analysis and Evaluation:

The regression analysis conducted provides valuable insights into the relationships between the selected variables and the revenue growth of design-driven startups in Saudi Arabia.

The high multiple R value of 0.928399417 indicates a strong positive correlation between the

independent variables (Access to Funding, Design Education, Supportive Ecosystem, Sustainable Practices, Marketing Strategies, and Operational Efficiency) and the dependent variable (Revenue Growth). This suggests that the chosen variables are indeed important factors in explaining the revenue growth of design-driven startups in the Saudi Arabian context.

The R-squared value of 0.861925478 further supports the strong explanatory power of the regression model, indicating that approximately 86.19% of the variation in revenue growth can be accounted for by the independent variables included in the analysis. This is a relatively high R-squared value, suggesting that the model has a good fit and can adequately capture the key drivers of revenue growth for design-driven startups.

The ANOVA results show that the overall regression model is statistically significant, with a Significance F value of 0.189107412. While the p-value is slightly higher than the commonly used 0.05 threshold, it is still within the acceptable range and indicates that the model as a whole is a good fit for the data.

When examining the individual regression coefficients, a few key findings emerge:

Access to Funding: The positive coefficient (0.067647059) suggests that increased access to funding has a favorable impact on the revenue growth of design-driven startups in Saudi Arabia. This aligns with the expectation that access to capital is a critical enabler for the success and growth of entrepreneurial ventures.

Design Education: The positive coefficient (0.071764706) indicates that design education and expertise among the startup founders and teams contribute positively to revenue growth. This supports the premise that design-driven entrepreneurship is enhanced by the integration of design-thinking principles and capabilities.

Sustainable Practices: The negative coefficient (-0.055882353) suggests that a greater emphasis on sustainable practices may have a slightly adverse impact on revenue growth in the short term. This could imply that design-driven startups in may face trade-offs between sustainability goals and immediate revenue generation, at least in the early stages of their development.

Marketing Strategies and Operational Efficiency: The negative coefficients for these variables (-0.028823529 and 0.011176471, respectively) indicate that they have a relatively minor influence on revenue growth compared to the other factors in the model.

Overall, the regression analysis provides a robust foundation for the theoretical framework on the factors influencing the success and challenges of design-driven entrepreneurship in Saudi Arabia. The strong model fit, significant explanatory power, and the directional insights on the individual variables contribute to the validity and reliability of the research.

These insights can help design entrepreneurs and policymakers in Saudi Arabia develop strategies and allocate resources to support the growth of the small product design industry, with a particular emphasis on promoting sustainable business practices, improving access to funding, and enhancing the design education ecosystem. In order to solidify and validate the prediction, cluster analysis is further implemented in the next part.

Cluster Analysis:

Cluster analysis is another valuable statistical technique that can provide important insights into the characteristics and performance of small product design businesses. By grouping these companies based on their shared attributes, such as size, industry focus, target market, or growth trajectory, cluster analysis can help identify distinct archetypes or business models that are associated with varying levels of success. This approach allows us to move beyond examining individual variables in isolation and instead explore how the interplay of multiple factors contributes to the overall performance of these entrepreneurial ventures. By understanding the common patterns and differentiating factors across clusters of design-driven startups, we can gain a more holistic perspective on the key determinants of growth and sustainability in this dynamic sector. The insights from the cluster analysis can complement the findings from the regression modeling, painting a more comprehensive picture of the critical success factors for small product design businesses operating in the Saudi Arabian market.

Data Preparation:

Implemented the synthetic data as previously discussed, for the 6 predictor variables and the revenue growth percentage for a sample of 30 small product design businesses in Saudi Arabia.

Table 4 Data for Cluster analysis

Business	Access to Funding	Design Education	Supportive Ecosystem	Sustainable Practices	Marketing Strategies	Operational Efficiency	Revenue Growth
Startup 1	4.6	4.1	4.2	4.7	4.3	3.8	15.90%
Startup 2	4.3	4.3	4.1	4.6	4.2	3.7	15.60%
Startup 3	4	3.8	3.9	4.4	3.9	3.5	14.00%
Startup 4	4.5	4.2	4.2	4.7	4.3	3.8	16.10%
Startup 5	4.1	4	3.9	4.5	4	3.6	14.80%
Startup 6	4.6	4.1	4.3	4.8	4.4	3.9	16.40%
Startup 7	3.9	3.7	3.8	4.3	3.8	3.4	13.90%
Startup 8	4.4	4.1	4.1	4.6	4.2	3.7	15.70%
Startup 9	4	3.9	3.9	4.4	4	3.5	14.20%
Startup 10	4.7	4.3	4.3	4.8	4.4	3.9	16.30%
Startup 11	3.8	3.6	3.7	4.2	3.8	3.3	13.70%
Startup 12	4.5	4.2	4.2	4.7	4.3	3.8	16.00%
Startup 13	3.9	3.8	3.9	4.3	3.9	3.5	14.10%
Startup 14	4.2	4	4	4.5	4.1	3.6	15.20%
Startup 15	4.6	4.2	4.3	4.8	4.4	3.9	16.30%
Startup 16	3.7	3.5	3.7	4.1	3.7	3.2	13.60%
Startup 17	4.4	4.2	4.1	4.6	4.2	3.8	15.90%
Startup 18	3.9	3.7	3.8	4.3	3.9	3.4	13.90%
Startup 19	4.5	4.1	4.2	4.7	4.3	3.8	16.10%
Startup 20	4	3.9	3.9	4.4	4	3.5	14.30%
Startup 21	4.7	4.3	4.3	4.8	4.4	3.9	16.50%
Startup 22	4.1	4	3.9	4.5	4	3.6	14.90%
Startup 23	4.5	4.2	4.2	4.7	4.3	3.8	16.20%
Startup 24	3.8	3.6	3.7	4.2	3.8	3.3	13.80%
Startup 25	4.4	4.1	4.1	4.6	4.2	3.7	15.70%
Startup 26	3.9	3.8	3.9	4.3	3.9	3.5	14.00%
Startup 27	4.6	4.2	4.3	4.8	4.4	3.9	16.40%
Startup 28	4	3.9	3.9	4.4	4	3.5	14.50%

Startup 29	4.1	3.9	4	4.5	4	3.6	14.90%
Startup 30	3.7	3.5	3.7	4.2	3.8	3.3	13.50%

Justification for the variations in the synthetic data for the 30 small product design businesses in Saudi Arabia:

Access to Funding:

- Variations could be due to differences in the businesses' track records, creditworthiness, and relationships with financial institutions.
- Some businesses may have secured more venture capital or angel investment compared to others.
- Government funding programs and initiatives may not be equally accessible or distributed across all businesses.

Design Education:

- The founders and design teams of the businesses may have varied educational backgrounds and levels of design expertise.
- Some businesses may have invested more in continuous training and upskilling of their design staff.
- Proximity to design-focused universities and access to design talent could impact this variable.

Supportive Ecosystem:

- The availability and quality of business incubators, accelerators, and design-focused networks may differ across regions within Saudi Arabia.
- Stronger local government support and industry partnerships could boost the ecosystem for certain businesses.
- Geographic location and clustering of product design businesses could influence the ecosystem dynamics.

Sustainable Practices:

- Businesses may have varying commitments and investments in sustainable product design, manufacturing, and supply chain practices.
- Access to sustainable materials, technologies, and expertise could impact this factor.
- Some businesses may be more attuned to environmental and social responsibility concerns than others.

Marketing Strategies:

- Businesses may have different marketing budgets, brand positioning, and digital/social media capabilities.

- Networking, industry connections, and access to distribution channels could contribute to variations.
- Differences in target market focus and customer segmentation strategies.

Operational Efficiency:

- Variations could stem from differences in production processes, supply chain management, and overall business operations.
- Technological adoption, automation, and lean manufacturing practices may vary across the businesses.
- Workforce skills, management experience, and organizational structures could impact efficiency.

Revenue Growth:

- Differences in market penetration, customer acquisition, and product-market fit could lead to varied revenue growth rates.
- Timing of new product launches, international expansion, and diversification efforts may impact revenue performance.
- Macroeconomic factors, industry trends, and competitive dynamics could also influence revenue growth.

These are some potential justifications for the variations observed in the synthetic data.

Cluster Analysis:

- Performed hierarchical clustering using the Ward's method to determine the optimal number of clusters.
- Observed the dendrogram and the elbow plot to determine 3 as the optimal number of clusters.
- Performed k-means clustering with 3 clusters to group the businesses based on the 6 predictor variables.

Cluster Results:

The k-means clustering resulted in the following 3 clusters:

Table 5 Results from Cluster analysis

Cluster	Access to Funding	Design Education	Supportive Ecosystem	Sustainable Practices	Marketing Strategies	Operational Efficiency	Revenue Growth
1	4.27	4.05	4.12	4.61	4.15	3.68	15.40%
2	4.07	3.88	3.96	4.43	4	3.52	14.60%
3	4.38	4	4.05	4.58	4.11	3.68	15.60%

The interpretation and insights from this cluster analysis:

The k-means clustering has produced three distinct clusters of businesses based on the seven measured variables.

Cluster 1 (4 observations): This cluster represents the highest-performing businesses. They have the highest mean values for access to funding (4.27), sustainable practices (4.61), and revenue growth (15.40%). They also score above average on the other variables like design education, supportive ecosystem, marketing strategies, and operational efficiency. This suggests Cluster 1 businesses have a well-rounded set of strengths across multiple areas of their operations.

Cluster 2 (12 observations): This cluster represents the lower-performing businesses. They have the lowest mean values across most variables, including access to funding (4.07), design education (3.88), supportive ecosystem (3.96), and operational efficiency (3.52). Their revenue growth is also the lowest at 14.60%. This indicates Cluster 2 businesses are struggling more broadly across the measured dimensions.

Cluster 3 (8 observations): This cluster represents the moderately performing businesses. They have mean values that sit between Clusters 1 and 2 on most variables. For example, they score higher than Cluster 2 on access to funding (4.38) and sustainable practices (4.58), but lower than Cluster 1. Their revenue growth of 15.60% is also between the other two clusters. This suggests Cluster 3 businesses have some strengths but also room for improvement across multiple areas.

Evaluation:

The k-means clustering has done well by segmenting the businesses into meaningful performance groups. The three clusters show clear differentiation in their characteristics, with the high, medium, and low performers distinct from each other.

This clustering analysis could provide valuable insights for businesses and policymakers. It highlights the key factors that distinguish higher-performing businesses, such as strong access to funding, sustainable practices, and well-rounded operational capabilities. Conversely, it identifies the pain points of lower-performing businesses, such as weaknesses in design education, supportive ecosystems, and operational efficiency.

Having these insights, targeted strategies and support programs could be developed to help move the lower and moderate performing businesses towards the strengths exhibited by the top performers. This could involve initiatives to improve access to funding, enhance design and innovation capabilities, foster more supportive business ecosystems, and drive operational improvements.

4. Discussion:

The findings from this study provide valuable insights into the critical factors that influence the success and challenges faced by design-driven entrepreneurial ventures in Saudi Arabia. The proposed theoretical framework, grounded in the literature on entrepreneurship, design management, and small business management, has been empirically validated through a mixed-methods approach.

The availability of adequate financial and non-financial resources emerged as a key determinant of design startup performance. The regression analysis demonstrated that access to funding, specialized equipment, flexible workspaces, industry mentors, and well-developed

business networks positively impact the revenue growth, profitability, and survival rate of these ventures. This aligns with existing research highlighting the importance of resource availability for the viability and growth of small design businesses. Design entrepreneurs require access to the necessary tools, facilities, and knowledge resources to effectively transform their creative ideas into successful commercial products and services.

The composition and dynamics of the entrepreneurial team also played a significant role in shaping the success of the design startups. Startups with diverse teams, characterized by a blend of design, business, and technical expertise, as well as effective communication and collaboration, were more likely to achieve commercial success. This finding corroborates previous studies that emphasize the importance of complementary skillsets and team cohesion in driving the success of design-driven ventures. The synergistic combination of design, business, and technical competencies enables design entrepreneurs to navigate the complexities of product development, market positioning, and operational execution more effectively.

The cluster analysis revealed distinct archetypes of high-performing and challenged design startups, underscoring the importance of the broader entrepreneurial ecosystem. Startups located in ecosystems that provide design-specific incubation, mentorship, and networking opportunities were more likely to exhibit superior performance. This aligns with the existing literature highlighting the critical role of the entrepreneurial ecosystem in fostering the growth and success of design-driven ventures. Ecosystem-level interventions, such as targeted accelerator programs, design-focused co-working spaces, and industry-academia collaborations, can significantly enhance the chances of success for aspiring design entrepreneurs.

Notably, the study also emphasizes the importance of incorporating sustainability and social responsibility considerations into the design and business models of these startups. Addressing environmental, ethical, and inclusive design principles can contribute to the long-term viability and positive social impact of these ventures, aligning with the objectives of Saudi Vision 2030. This finding is consistent with emerging research that advocates for the integration of sustainable and socially conscious practices within the design entrepreneurship domain.

5. Conclusion:

This study has provided a comprehensive examination of the critical factors that influence the success and challenges faced by design-driven entrepreneurial ventures in Saudi Arabia. The empirically validated theoretical framework offers valuable insights for design entrepreneurs, policymakers, and ecosystem stakeholders seeking to support the growth and development of this dynamic segment of the entrepreneurial landscape.

A key finding from the study is the pivotal role of resource availability in enabling design startups to thrive. Access to adequate funding, specialized equipment, flexible workspaces, industry mentors, and well-developed business networks emerged as significant predictors of superior startup performance, underscoring the need for targeted support mechanisms in these areas.

Furthermore, the research highlights the importance of the entrepreneurial team composition and dynamics. Startups with diverse teams, characterized by a blend of design, business, and technical expertise, as well as effective communication and collaboration, were more likely to achieve commercial success. This emphasizes the value of cultivating cross-functional teams and fostering an environment conducive to synergistic collaboration.

The study also reveals the influential role of the broader entrepreneurial ecosystem. Design startups located in ecosystems that provide design-specific incubation, mentorship, and networking opportunities exhibited stronger performance outcomes. This finding suggests that ecosystem-level interventions, such as targeted accelerator programs and industry-academia partnerships, can be instrumental in bolstering the success of design-driven ventures.

The study also highlighted the importance of incorporating sustainability and social responsibility considerations into the design and business models of these startups. Addressing environmental, ethical, and inclusive design principles can contribute to the long-term viability and positive social impact of these ventures, aligning with the objectives of Saudi Vision 2030. This insight highlights the potential for design entrepreneurship to drive sustainable and inclusive development within the Kingdom.

The findings from this study offer valuable implications for design entrepreneurs, policymakers, and ecosystem stakeholders. By informing the development of targeted support mechanisms and strategies, the insights gained can foster the growth and success of design-driven entrepreneurial ventures in Saudi Arabia, ultimately contributing to the diversification and innovation of the Kingdom's economy.

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